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Inventor: **Rainald Sander**

Attorney Docket No.: **P00,0184.**

Patent Application Entitled:

**"TEMPERATURE-PROTECTED SEMICONDUCTOR SWITCH"**

John Sansone

Signature of person Mailing application

7-13-04

AF/2814 #



# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

## APPELLANT'S APPEAL BRIEF TRANSMITTAL LETTER

| | | | |
|---|---|---|---|
| APPELLANT: | Rainald SANDER | DOCKET NO: | P00,0184 |
| SERIAL NO.: | 09/497,618 | ART UNIT: | 2814 |
| FILED: | February 3, 2000 | EXAMINER: | D Farahani |
| CONF. NO. | 7717 | | |

TITLE: TEMPERATURE-PROTECTED SEMICONDUCTOR SWITCH

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

Appellants are submitting herewith, in triplicate, Appellants' Brief Under 37 C.F.R. §1.192 in support of the Notice of Appeal filed May 10, 2004.

Appellant requests that the appeal brief fee of $320.00 previously paid on March 26, 2003 be applied to the present appeal brief fee of $330.00 due as required by 37 C.F.R. §1.17(c). The Commissioner is hereby authorized to charge the remaining $10.00 and any additional fee that may be required to deposit account No. 50-1519. A duplicate copy of this sheet is enclosed.

Adjustment date: 07/15/2004 HALI11
04/02/2003 AWISE1 00000014 09497618
01 FC:1402 -320.00 OP

07/15/2004 HALI11 00000046 501519 09497618
01 FC:1402 10.00 DA 320.00 OP

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# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
# BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

## APPELLANT'S MAIN BRIEF ON APPEAL (SECOND)

| | | | |
|---|---|---|---|
| APPELLANT: | Rainald SANDER | DOCKET NO: | P00,0184 |
| SERIAL NO.: | 09/497,618 | ART UNIT: | 2814 |
| FILED: | February 3, 2000 | EXAMINER: | D Farahani |
| CONF. NO. | 7717 | | |

TITLE: TEMPERATURE-PROTECTED SEMICONDUCTOR SWITCH

Mail Stop Appeal Brief-Patents
Commissioner for Patents
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Sir:

In accordance with the provisions of 37 C.F.R. §1.192, Appellant submits this Brief in support of the appeal of the above-referenced application, in triplicate, in support of the patentability of claims 1-9 finally rejected in the Office Action, dated December 9, 2003 ("OA"). A telephone interview with the Examiner conducted on April 15, 2004 did not result in agreement, as evidenced by the Telephone Interview Summary dated April 21, 2004. A copy of the claims on appeal is attached as Appendix A. A Notice of Appeal was filed on May 10, 2004.

## REAL PARTY IN INTEREST

The real party in interest in this appeal is the assignee, Infineon Technologies AG, a German corporation, by virtue of an assignment executed June 26, 2000 and recorded on July 17, 2000 at reel/frame: 010978 / 0876.

## RELATED APPEALS AND INTERFERENCES:

There are no related appeals and no related interferences known to Appellant, Appellant's Assignee, or Appellant's legal representative.

## STATUS OF CLAIMS:

Claims 1-9 are on appeal, and constitute all pending claims of the application. In paragraph 2 of the OA, the claims were rejected under 35 U.S.C. §102 and §103 based on prior art as follows:

| Claims / Section | 35 U.S.C. Sec. | References / Notes |
|---|---|---|
| 1, 2, 4-6, 8, 9 | §102(b) Anticipation | • Furuhata (U.S. Patent No. 5,521,421). |
| 3,7 | §103(a) Obviousness | • Furuhata (U.S. Patent No. 5,521,421); and<br>• Roth, Fundamentals of Logic Design (1992). |

## STATUS OF AMENDMENTS:

No amendments have been entered in this case. All claims presented are those originally filed.

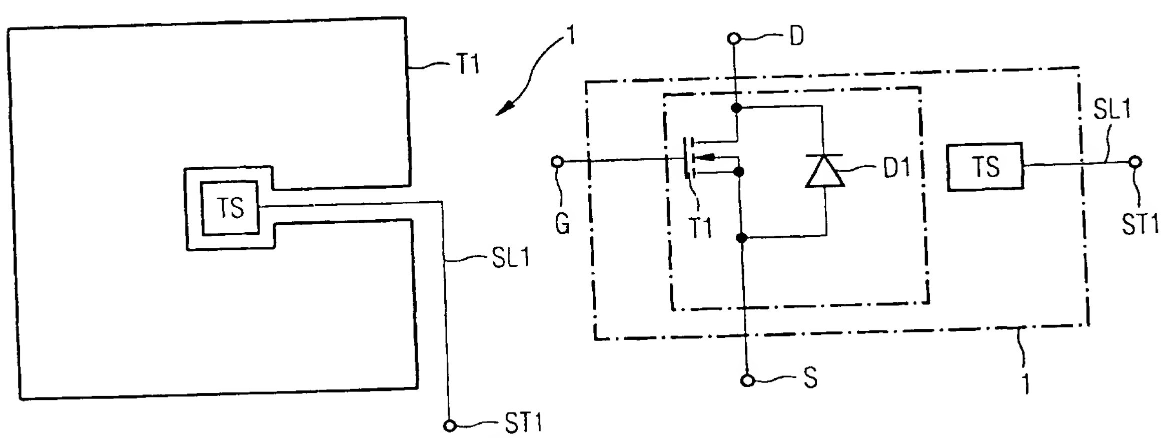
## SUMMARY OF THE INVENTION:

In general terms, the present invention is a temperature-protected semiconductor switch that has both a temperature sensor configured to output a first signal, and a charge carrier detector configured to output a second

signal. These two signals can be used to provide an accurate indication of when a true overtemperature situation occurs at the switch or whether a false positive overtemperature situation has been triggered by the presence of problematic free charge carriers.

It is known to provide power switches with integrated temperature sensors to prevent thermal overload. These temperature sensors acquire the temperature of the power switch and convert this into a temperature-dependent analog signal which then can be interpreted in an evaluation circuit—the circuit can then be used to shut off the semiconductor switch when a predetermined temperature has been exceeded. p. 1, 2nd ¶. Figures 1A and 1B below of the application illustrate such a known configuration. An exemplary switch element T1 that is a MOSFET is shown below. p. 2, first carryover ¶.

FIG 1A FIG 1B




*Figs. 1A & 1B*
*Known Switch with Temperature Sensor*

MOSFET-type switches often include a reverse diode D1 that is integrated with the switch in a semiconductor body—however, when operated

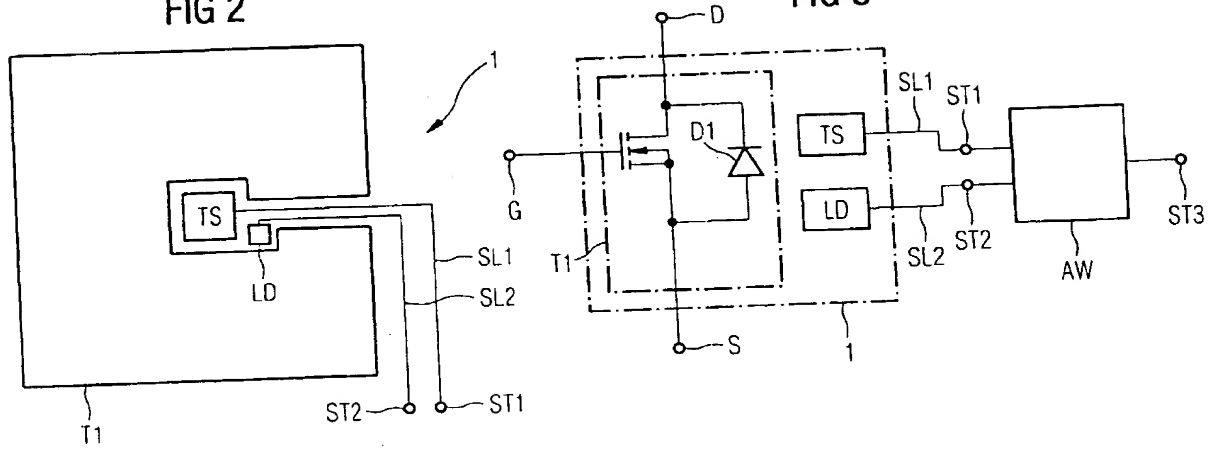
in a certain manner, this diode produces free charge carriers. These free charge carriers are problematic, however, because they can induce the temperature sensor TS to trigger a false positive overtemperature when no such overtemperature is present. p. 2, 2nd ¶.

One known solution that has been provided is to provide a charge carrier diffusion ring around the temperature sensor (see the ring around TS in Fig. 1A) that can block the free charge carriers and thus prevent false positive overtemperatures. Unfortunately, in order for the ring to adequately block (capture) the problematic charge carriers from the temperature sensor TS, this ring would have to be implemented very broadly (large), meaning that the temperature sensor TS would be located far away from the hottest location of the switch that is to be protected (and thus, have too slow of a reaction time to signal shutting the switch off). But if the temperature sensor is located close to the switch to improve reaction time, then the protective ring cannot sufficiently block the free charge carriers, thus increasing the probability of false positive overtemperature conditions by the temperature sensor. p. 3, first carryover ¶.

The invention addresses this problem by providing a charge carrier detector that provides an additional signal that can be used to protect the switch. p. 3, 2nd full ¶. The charge carrier detector permits the temperature sensor to be located near the switch, but the charge carrier detector provides information that permits one to distinguish between a temperature sensor signal due to a true overtemperature situation and a false overtemperature

sensor signal triggered by the charge carriers. p. 3-4, last/first carryover ¶. Refer to the exemplary embodiment illustrated below.

FIG 2 FIG 3




*Figs. 2 & 3*
*Exemplary Embodiment of the Invention*

It can be seen from Figs. 2 and 3 that the charge carrier detector LD connects to a line SL2 via which a second signal can be output when the free charge carriers are detected. When the temperature sensor TS it triggered, it may be either because of a true over-temperature condition or because of the problematic charge carriers. If the signal from the charge carrier detector LD is present, then one can presume that the over-temperature signal provided by the temperature sensor TS is erroneous and not shut down the switch T1.

**ISSUES:**

The issues on appeal are as follows:

1. Whether the subject matter of claims 1-2, 4-6, 8 and 9 are anticipated by Furuhata (U.S. Patent No. 5,521,421); and

2. Whether the subject matter of claims 3 and 7 is obvious in view of

Yamaguchi over Roth, Fundamentals of Logic Design, 1992.

## GROUPING OF CLAIMS:

The claims on appeal include one independent claim (claim 1) and eight dependent claims (2-9).

### Group 1: claims 1, 2, 4-6, 8 and 9

The primary basis of dispute for the rejection revolves around elements of independent claim 1. Appellant groups dependent claims 1, 2, 4-6, 8, and 9 in the group with claim 1.

### Group 2: claims 3 and 7

Appellant believes that dependent claims 3 and 7 are separately patentable, and thus places them in a third group for appeal. These claims are separately patentable since the require the presence of a logic element that relates the first and second signals to the actions of determining whether to protect the switch or not. There mere presence of a charge carrier detector according to claim 1 is advantageous, but how to utilize the signal originating with the charge carrier detector provides operational advantages to the circuit that are not present with the charge carrier detector or its appertaining signal alone.

## ARGUMENTS:

***ARGUMENT 1–Anticipation by Furuhata of Claim 1 (and other dependent claims)***

***Examiner's Position: Claim 1 is anticipated by Furuhata because the switch element, the temperature sensor (and its generated first signal), and the charge carrier detector, are all disclosed by Furuhata.***

In the OA, p. 2, the Examiner states:

> Furuhata discloses in figures la-lb, a temperature-protected semiconductor switch, comprising a semiconductor body of a first conductivity type, N, a semiconductor switch element, 11 and 12, formed of a plurality of cells connected in parallel and including an integrated reverse diode (see column 3, lines 63-64), a temperature sensor (the bipolar transistor included inherently in the power MOSFET block 11, and the base of the transistor, that is the transistor comprising regions 14b, 1 6b, and 13, is leading out of the substrate through 16b) which generates a first signal in the occurrence of an excess temperature, and a charge carrier detector (the PN junction of the region 14a and 13).

This language was carried over from a prior Office Action (dated June 11, 2003).

In addressing the Appellant's response that Furuhata fails to teach a charge carrier detector that generates a second signal given the occurrence of free charge carriers in the semiconductor body, the Examiner responded in the OA on p. 5 that the provided arguments were not persuasive, stating:

> Applicant's arguments filed 9/8/03 have been fully considered but they are not persuasive.
>
> Applicant argues that Furuhata does not describe a charge carrier detector, and that the examiner's interpretation of the PN junction in the reference is wrong. Note that any PN junction forms a diode, which inherently is a charge carrier detector,

> regardless of the particular function the diode has in a device.
>
> Applicant further argues that the primary reference does not disclose the temperature sensor is integrated in the body. The examiner notes that "integrated" is defined as to unite with something else. This definition clearly reads on the reference.

During the telephone interview with the Examiner conducted on April 14, 2004, the Appellant asked the Examiner to indicate how Furuhata's "charge carrier detector", as analogized by the Examiner, disclosed generating a second signal given the occurrence of free charge carriers in the semiconductor body.

The Examiner replied, as indicated in the Interview Summary, dated April 21, 2004:

> [T]he diode in the reference is the charge carrier detector that generates a second signal in [sic: the] presence of charge carriers.

Thus, the Examiner is equating the elements of claim 1 with the following elements of Furuhata

| **Claim 1 element** | **Furuhata** |
|---|---|
| Semiconductor switch element formed of a plurality of cells connected in parallel and including an integrated reverse diode | Semiconductor switch element 11 & 12 formed of a plurality of cells connected in parallel and including an integrated reverse diode (col. 3, lines 63-64).<br>"Integrated" is defined as to unite with something else, and this definition clearly reads on the reference. |
| Temperature sensor that generates a first signal given the occurrence of | A temperature sensor (the bipolar transistor included inhereintly in the |

| | |
|---|---|
| an excess temperature, wherein the semiconductor switch element and the temperature sensor are integrated together in the semiconductor body. | power MOSFET block 11, and the base of the transistor, that is the transistor comprising regions 14b, 16b, and 13, is leading out of the substrate through 16b) which generates a first signal in the occurrence of an excess temperature. |
| Charge carrier detector generating a second signal when free charge carriers are present in the semiconductor body | The PN junction of the region 14a and 13.<br><br>The PN junction forms a diode, which inherently is a charge carrier detector, regardless of the particular function the diode has in a device, and this generates a second signal in the presence of charge carriers. |

***Appellant's Position: The Examiner has misconstrued the elements of the claim, and has ignored various elements, their relationships and functions in forcing the Furuhata reference to improperly read on elements of claim 1 of the present invention.***

The present invention requires the presence of four elements (the semiconductor body, the semiconductor switch, the temperature sensor, and the charge carrier detector) and requires the prescribed interrelationship as described in the claims, namely that the switch element, the temperature sensor, and the charge carrier detector are all separate elements.

*1. Furuhata fails to teach each and every element of the present invention because it fails to teach a charge carrier detector that generates a second signal given the occurrence of free charge carriers in the semiconductor body.*

In the OA, under numbered paragraph 2, the Examiner indicates that Furuhata discloses a charge carrier detector, referring to the PN junction of the region 14a and 13, according to Figures 1a-1b. According to claim 1 of the present invention, a charge carrier detector generates a second signal given the occurrence of free charge carriers in the semiconductor body.

The Examiner indicated that a PN junction forms a diode which is inherently a charge carrier detector. Any doped semiconductor material carries charges—the very name "semiconductor" implies that the material partially conducts electricity, which infers that it carries charges. However, to broadly assert that any and every PN junction serves as a *detector* that produces a *signal* is improper.

Furuhata provides no disclosure of the PN junction of the region 14a and 13 serving to determine the presence of a signal or serving to extract intelligence from a signal.

Referring to Figures 1a and 1b of Furuhata, these figures describe a semiconductor device including a power MOSFET and a temperature monitor element. The power MOSFET includes a plurality of cells connected in parallel. Each of these cells comprises a body-zone 14a, 14b disposed in a semiconductor body 13 and are complementarily doped to the semiconductor body 13. These cells furthermore include source-zones 15a, 15b that are complementarily doped to the body-zones 14a, 14b and gate-electrodes 16a, 16b for controlling a current path between the source-zones 15a, 15b and parts of the semiconductor body 13, with the latter serving as the drift zone of

the power MOSFET.

Furuhata does state, at 3/62-64, "The temperature monitor element may utilize a reverse leakage current through the PN-junction," but fails to disclose any additional information about the cause of the reverse leakage current (but which presumably results from a reverse biasing voltage across the PN-junction, and not due to the presence or absence of free charge carriers in the semiconductor body) or how a second signal is generated in response to free charge carriers in the semiconductor body.

Furuhata further states, at 4/9-20:

> In case of an accident, an excessive current may flow through the source region layers 15a, 15b, the back gate region layers 14a, 14b, and the silicon substrate 13. In this case, excessive heat may be generated mainly from the PN-junctions between the source region layers 15a, 15b, and the back gate region layers 14a, 14b, or from the PN-junctions between the back gate region layers 14a, 14b, and the silicon substrate 13. The excessive heat is conducted across three sides of the temperature monitor element to the temperature monitor element 18 through the silicon substrate 13 and the source electrode 17, and detected by the monitor element 18.

This section discusses how when excessive current flows, heat may be generated at this PN-junction and is thereby conducted to the monitor element 18. But the mere transference of heat is not what is being addressed by the charge carrier detector of the present invention. The charge carrier detector of the present invention addresses providing the ability to distinguish false positives of over-temperature caused by the presence of free charge carriers.

Clearly Furuhata cannot accomplish this because it fails to generate a second signal given the occurrence of free charge carriers. Furuhata does not address the problems that are caused by the presence of free charge carriers in the semiconductor body (i.e., triggering false over-temperature signals), and the PN-junction of Furuhata operates no differently (at least no distinction can be made given the disclosure of Furuhata) whether there are free charge carriers in the semiconductor body or not—a detector is not a very good detector if it responds the same way to every single situation.

In sum, Furuhata fails to disclose how this PN junction 14a, 13 serves to generate a second signal given the occurrence of free charge carriers in the semiconductor body, as it would be required to do given the Examiner's interpretation of Furuhata.

*2. Furuhata fails to teach each and every element of the present invention because it fails to describe a temperature sensor integrated <u>in</u> the semiconductor body.*

According to claim 1 of the present invention, the temperature sensor is integrated *<u>in</u>* the semiconductor body along with the switch element (see Fig. 4 of the present invention).

The semiconductor device according to Furuhata includes a temperature monitor element 18 that is disposed above a surface of the semiconductor body 13 and is electrically insulated from the semiconductor body 13 by insulating layer 19.

The Examiner ignored the use of the word "in", when addressing this

claim element simply stating, "'Integrated' is defined as to unite with something else, and this definition clearly reads on the reference." The claim element does not simply say "integrated", it says "integrated together *in* the semiconductor body". While the Examiner is free to construe the terms of a patent claim broadly, he cannot simply ignore words that define the scope of the claim—in this case, the Examiner ignored the word "in" when reading Furuhata on the elements of claim 1 of the invention.

In summary, the present invention requires the presence of four elements (the semiconductor body, the semiconductor switch, the temperature sensor, and the charge carrier detector) and requires the prescribed interrelationship as described in the claims. Furuhata lacks a teaching of these four elements and their respective relationships to one another and thus cannot anticipate the present invention. The present invention's use of all of these elements presents an advantageous architecture and functionality over the invention disclosed by Furuhata.

For this reason, Appellant believes that an element required by claim 1 is not found in Furuhata and thus Furuhata cannot be said to anticipate the present invention. Since all remaining claims depend from claim 1, Appellant respectfully request that the Examiner's §102 rejection be reversed in the present application.

***ARGUMENT 2–Obviousness by Furuhata and Roth of Claim 3 (and dependent claim 7)***

***Examiner's Position: Claims 3 and 7 are obviated by the combination of Roth because Roth teaches the functions of an exclusive-or logic gate.***

In the OA, on p. 3, the Examiner states that:

> Roth teaches at page 51 an exclusive-or logic gate. It would have been obvious to one of ordinary skills in the ad at the time the invention was made to use an exclusive-or logic gate in Furuhata to get an output signal corresponding to the temperature and charge carrier input signals. It is well known in the art that an exclusive-or logic gate outputs 1, or H, when one of its inputs is 0, or L, and the other input is 1, or H.

***Appellant's Position: The addition of Roth's general teaching of the functions of an exclusive-or logic gate does not serve to obviate a claim element directed to an evaluation means wherein the first and second [charge carrier detection] signals are provided to indicate an unambiguous excess temperature in the semiconductor switch element.***

Appellants do not disagree that Roth teaches the basic functions performed by an exclusive-or logic gate. However, the Examiner's failure to describe, as noted above, how the charge carrier detection signal is produced in response to free charge carriers in the semiconductor body according to Furuhata suggests that a reference simply describing the basic operational functions of an exclusive-or gate does not obviate an element permitting the discrimination of a false-positive over-temperature signal (i.e., "indicating an unambiguous excess temperature").

According to the Specification on p. 6, the evaluator means checks to see if the temperature sensor signal is high. If so, a check is made to see if

the charge carrier detector is high as well. If it is, this signals a false positive from the temperature sensor (i.e., caused by the presence of spurious charge carriers and not by a true over-temperature condition)—the output of the evaluator is low and no further action is taken.

If, however, the temperature sensor signal is high, and the charge carrier detector is low (indicating no problematic spurious charge carriers are present), then this reflects a true over-temperature condition and the output of the evaluator means is high, which triggers a switch shut-off mechanism.

The Examiner indicates that it would be obvious to combine the exclusive-or gate with Furuhata to produce the proper output signal corresponding to the temperature and charge carrier input signals, but does not even explain how the PN-junction he equates with the charge carrier detector even produces a logical zero or one value—and without providing that, then why would an exclusive-or gate be proper to use in this situation? Why wouldn't an AND gate, an OR gate, inverters, or some other combination of logic be appropriate?

Whatever function the PN junction of Furuhata performs, it is not one of performing charge carrier detection given the occurrence of free charge carriers in the semiconductor body. One of the basic requirements of a *prima facie* case of obviousness is that there must be some suggestion or motivation to combine the references. Here, applying an exclusive-or logic gate having as one of the inputs being a signal of questionable function (the "signal" the Examiner equates as being produced by the PN junction of

Furuhata) would produce an output having a similar questionable function—there would be no motivation for adding an exclusive-or gate to a "detector" that does not serve to detect the occurrence of free charge carriers in the semiconductor body.

For these reasons, Appellant asserts that the claim language clearly distinguishes over the prior art, and respectfully request that the Board reverse the Examiner with respect to the 35 U.S.C. §103(a) rejection.

**CONCLUSION:**

For the above reasons, Appellants respectfully submits that the Examiner is in error in law and in fact in rejecting claims 1-9 based on the teachings of the above-discussed references. Reversal of the rejection of all of those claims is justified, and the same is respectfully requested.

Appellant requests that the appeal brief fee of $320.00 previously paid on March 26, 2003 be applied to the present appeal brief fee of $330.00 due as required by 37 C.F.R. §1.17(c). The Commissioner is hereby authorized to charge the remaining $10.00 and any additional fee that may be required to deposit account No. 50-1519.

Respectfully submitted,

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## APPENDIX A
## CLAIMS INVOLVED IN THE APPEAL

1. (original) A temperature-protected semiconductor switch, comprising:

a semiconductor body of first conductivity type;

a semiconductor switch element formed of a plurality of cells connected in parallel and including an integrated reverse diode;

a temperature sensor which generates a first signal given the occurrence of an excess temperature, wherein the semiconductor switch element and the temperature sensor are integrated together in the semiconductor body; and

a charge carrier detector that generates a second signal given the occurrence of free charge carriers in the semiconductor body.

2. (original) A temperature-protected semiconductor switch as claimed in claim 1, further comprising:

a parasitic component formed between the charge carrier detector, the semiconductor body and it least one cell M f the semiconductor switch element.

3. (original) A temperature-protected semiconductor switch as claimed in claim 1, further comprising:

in evaluation means, wherein the first and second signals are supplied to the evaluation means and logically operated with one another thereat for indicating an unambiguous excess temperature in the semiconductor switch element.

4. (original) A temperature-protected semiconductor switch as claimed in claim 1, wherein the charge carrier detector is positioned adjacent the temperature sensor.

5. (original) A temperature-protected semiconductor switch as claimed in claim 1, wherein the temperature sensor is attached proximate a hottest location of the semiconductor body

6. (original) A temperature-protected semiconductor switch as claimed in claim 1, wherein the charge carrier detector is positioned adjacent a signal line of the temperature sensor leading out of the semiconductor switch.

7. (original) A temperature-protected semiconductor switch as claimed in claim 3, wherein the evaluation means is monolithically integrated with the semiconductor switch.

8. (original) A temperature-protected semiconductor switch as claimed in claim 1, further comprising:

at least one of a bipolar transistor and a thyristor as the temperature sensor.

9. (original) A temperature-protected semiconductor switch as claimed in claim 1, wherein the first conductivity type is n-conductive.